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$\delta^{13}C$, $\delta^{18}O$ and $^{87}Sr/^{86}Sr$ isotope composition of Montney Formation carbonate phases: implications for the nature of diagenetic fluids

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The Montney Formation, western Canada's leading unconventional tight gas play, is a siltstone-dominated reservoir with a complex diagenetic history. Previous diagenetic studies of the Montney Formation are mainly centered on the effect of diagenesis on reservoir quality and porosity evolution with minimal application of isotopic studies to address water-rock interaction and origin of diagenetic fluids in this Formation. This study presents preliminary results of petrographic studies and bulk stable isotope data from calcite and dolomite plus bulk $^{87}Sr/^{86}Sr$ ratio analyses to investigate the nature of the diagenetic fluid(s) and geochemical processes involved during diagenesis of the Montney Formation in western Alberta and northeastern BC.

Petrographic studies show that dolomite occurs as ferroan zoned and non-ferroan pore-filling cement, mostly nucleated on rounded detrital grains. Calcite exists as non-ferroan to ferroan pore-filling, ferroan replacive, and non-ferroan poikilotopic cement. The $\delta^{13}C$ and $\delta^{18}O$ values of dolomite range from -6.5 to 0.4 ‰ (V-PDB) and -2.8 to -7.8 ‰ (V-PDB), respectively. Calcite exhibits similar $\delta^{13}C$ values to dolomite ranging from -0.1 to -7.1 ‰ (V-PDB) with a narrower range of $\delta^{18}O$ values varying from -6.0 to -9.5 ‰ (V-PDB). The preliminary $^{87}Sr/^{86}Sr$ isotope composition of three measured samples varies from 0.7105 to 0.7111.

Carbon and oxygen isotope composition of both calcite and dolomite are depleted in comparison to the reported range of $\delta^{13}C$ and $\delta^{18}O$ for the Triassic marine calcite and dolomite. This suggests that the isotopic composition of the Montney Formation carbonates is strongly influenced by diagenetic fluids that originated from source(s) other than the Triassic seawater derived pore water. Calcite and dolomite from northeastern BC are more depleted in ^{18}O correlating with elevated burial temperature of the Montney Formation in this region. The ^{18}O-depleted dolomite from the area of lower burial temperature in western Alberta is likely linked to hydrothermal activity. Negative $\delta^{13}C$ values of both calcite and dolomite are probably indicative of diagenetic fluids depleted in ^{13}C derived from decomposition of organic matter during burial. Preliminary $^{87}Sr/^{86}Sr$ ratio analysis also suggests that Montney Formation carbonate phases were formed from fluids enriched in radiogenic Sr isotope. Further work is underway to determine the strontium isotopic composition of individual phases. This may further confirm contribution of fluids other than coeval Triassic pore water to precipitation of carbonates in the Montney Formation.